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SCIENCE AND SCRUPLES

Francois Magendie (1783-1855) and Sir Charles Bell (1774-1842)

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In the early part of the nineteenth century there began a scientific controversy that has never been finally settled and, in fairly close connection with this, an ethical controversy that still flares up at intervals to the present day. An anatomist in London and a physiologist in Paris each claimed priority in an important neurological discovery. The anatomist, whose father was a minister, introduced into the dispute scruples against inflicting pain; whereas the physiologist, whose father was a surgeon, was cited as a horrid example of the ruthless and sadistic experimenter on living animals.

The discovery, for which credit was disputed by Charles Bell in London and François Magendie in Paris, is the function of the spinal nerve roots. The Bell-Magendie law, as the formulation of the function of spinal nerve roots is sometimes called, has been compared in importance to the discovery of the circulation of the blood. The law states that the ventral roots are motor and the dorsal roots sensory in function.

The disputants in the controversy were Charles Bell, an anatomist and surgeon, and François Magendie, a physiologist and physician. Bell, artistically inclined, laid more emphasis on form, but Magendie liked experiment. As we shall see, the personalities of the two men are of great interest.

Bell's attitude toward any experiment which inflicted pain was to dispense with it if at all possible, although he did plan a number of classical animal experiments, some of which he performed himself. He was equally reluctant to inflict pain on human beings and, as a surgeon, was noted for his small incisions.

His comments on experimentation are characteristic of his attitude. He speaks of "delaying long because of the unpleasant nature of the operation" and being "deterred from repeating the experiment by the protracted cruelty of the dissection." In 1822 he wrote: "I should be writing a third paper on the nerves, but I cannot proceed without making some experiments that are so unpleasant to make that I defer them. You may think me silly but I cannot convince myself that I am authorized in nature or religion to do these cruelties—for what? for anything else than a little egotism or self aggrandisement?" On one occasion he used an animal which had been rendered insensible by a blow on the head. Because the animal was unconscious some important observations were impossible. Bell went as far as to say: "Experiments have never been the means of discovery and a survey of what has been attempted of late years in physiology will prove that the opening of living animals has done more to perpetuate error than to confirm the just views taken from the study of anatomy and natural motions"; and again: "I feel a hesitation when I reason upon other ground than on the facts of anatomy. Experiments are more apt to be misinterpreted."

Magendie, in contrast, boldly asserted: "Not one of the facts which compose the physiology of today has been proved or could have been proved except by experiment." He was an experimenter on a grand scale. He made use of the lesson of one experiment to plan a more perfect succeeding experiment. He was

admittedly rash in satisfying his curiosity during operations on human beings. This helps to explain why later, when anesthesia was introduced into the practice of surgery, he opposed it. "Pain?" he said. "Pain is one of the prime movers of life. As for myself, I should never allow my body to be handed over to a surgeon in a defenseless state."

Regardless of the relative advantages of the study of form compared with experiment on living tissues, Magendie came nearer the truth than Bell did when trying to discover the meaning of the spinal nerve roots. This seems to have as much to do with the preconceived idea which each had as with the method used. At the time of his investigations, Bell was imbued with the most comprehensive idea of the nervous system yet known. He was concerned with both sensorimotor functions and what he called "inner vital" functions. He had the germ of a conception of the automatic nervous system. His experiments, which were limited in number and in scope, led to observations which he was able to fit into the frame of his brilliant speculations, and he was only partly right. It is to be admitted that Bell's writing was a little difficult to understand and, even with a smattering of French, it is easier to understand Magendie. The latter was by philosophy a mechanist, primarily interested in sensation and motion, and not at the time of his discovery preoccupied with any idea about vital functions. Magendie's simpler idea proved to be right, so far as sensory and motor function are concerned.

Even though Magendie seemed to have no scruples about inflicting pain upon animals, he was truly sympathetic with human suffering. He was known to give money as well as medicine to the poor. He had little confidence in many of the remedies that were in vogue, largely limiting his prescriptions to medicines that he had investigated experimentally. He would give no treatment whatever in cases that he did not understand. He was often delegated by the Academy of Sciences to visit its ailing members. These scientists probably wanted no hocus pocus when they became patients.

Bell, scrupulous as he was in some matters, did a rather strange thing in his scientific reports. He altered and clarified his writings from time to time, so that they were more accurate and impressive in their revision than in their original form. At first his corrections were confined to conclusions; later they were introduced into descriptions of his experiments. He failed to indicate definitely that he had made any changes, so that unsuspecting readers believed they were studying verbatim reprints, and did not know of the revisions. Magendie detected this practice and observed, "Why does he harbor pretentions to discoveries which he has not made?" In this respect Bell displayed the amazingly naïve behavior so puzzling to see in unquestionably honest people.

An interesting quirk of Magendie's was his habit of completing an investigation before consulting the writings of others. He more than once enjoyed the thrill of discovery, followed by the chagrin of finding that his discovery had been anticipated. His custom was to reprint the prior report in his *Journal of Physiology*.

Bell's claim to priority in discovering the functions of the spinal nerve roots rose out of the fact that in 1809 he had had printed a pamphlet with the title *A New Idea of the Anatomy of the Brain, Submitted for the Observation of His Friends* (London, Strahan, and Preston), and in this pamphlet he had referred to the functions of these roots. He said: "I found that injury done to the anterior portion of the spinal marrow convulsed the animal more certainly than injury done to the posterior portion," and "on laying bare the roots of the spinal nerves I found that

I could cut across the posterior fasciculus of nerves, which took its origin from the posterior portion of the spinal marrow, without convulsing the muscles of the back; but that on touching the anterior fasciculus with the point of the knife, the muscles of the back were immediately convulsed." However, his conclusion seemed to be that the anterior roots were motor and sensory (sensible) and that the posterior roots served to govern vital functions (insensible, in Bell's original terminology). This reasoning came from the fact that Bell thought the cerebellum had to do with vital functions, and that the posterior columns of the spinal cord seemed to connect with the cerebellum, whereas the anterior columns could be traced down from the cerebral hemispheres, where Bell rightly assumed sensation and motion were seated.

The first intimation of Bell's idea was in a letter to his brother George. In this letter, dated 1807, he wrote, "I have done a more interesting nova anatomia cerebri than it is possible to conceive." Bell always gave 1809 as the date of his printed report, but historians now assign the actual date as 1811. The uncertainty is because the publication bears no date. The three known surviving copies are now treasured in libraries. One is in the Army Medical Library in this country.

Magendie's claim to the same discovery is based on a report published in his *Journal of Physiology* (J. de physiol. exper. et path. 2:276-279, 1822). Utilizing "a litter of 8 little dogs, aged 6 weeks," he made experiments which led him to "regard as probable that the posterior roots of the spinal nerves might have functions different from those of the anterior roots and that they were especially connected with sensibility. The posterior roots appear to be more especially appropriated to sensation, while the anterior appear to be especially associated with movement."

By October, 1822, Magendie had heard of Bell's claim to priority, and he said he could not have known of Bell's ingenious ideas since they had not been published. "The fact that the anterior (roots) are destined for movement while the posterior belong more particularly to sensation would appear to have escaped him. He, led by his ingenious ideas, had been very close to discovering the functions of the spinal roots."

It should be mentioned that in 1821 John Shaw, Bell's brother-in-law and associate in teaching, visited Magendie and gave some demonstrations. He also left with Magendie a copy of a dissection manual which contained a footnote referring to some experiments in progress which might have had to do with the spinal nerve roots but not giving the conclusions drawn. Whether Shaw and Magendie discussed this problem we are not sure.

It will be interesting to point out some similarities in the two scientists. In 1811, the year of his marriage and we believe also of his famous report on his "New Idea" of the nervous system, Bell was 37 years old. Magendie, in 1822, when he published his observations on the spinal nerve roots, was 38. Both men became famous and successful and received the customary honors bestowed on men of achievement in their respective countries. Yet both had a hard struggle at first. Their early education was informal rather than formal, although in the end both were gentlemen of learning and distinction. Each passed through a period of melancholy when on the threshold of success. Bell, who invading London from Edinburgh arrived in London on a Sunday after a trip of five days, found the city very depressing. He suffered rebuffs that would have discouraged most men. Magendie, when earning barely enough to sustain himself and his dog, began to think he suffered from a deep-seated incurable disease, and informed his friends that he would soon die. However, a legacy of 20,000 francs cured the melancholy.

He may have learned then that in some cases money is the best medicine. Both men were high tempered, especially when arguing about their scientific interests. Bell on one occasion thought it necessary to correct an impression (which was probably quite a general one) that he was pugnacious and sarcastic. Magendie sometimes acted as if he had invented the science of physiology, and was subject to rages when he thought someone was invading his province. Although both married, neither had a child; their creative energies seemed to be pre-empted by science. Both died with heart disease. Bell, who was so sensitive about pain, suffered from angina pectoris. Magendie, who rather approved of pain, also had heart disease, and his share of pain too.

The controversy which waged between Magendie and Bell seemed to bring out the most regrettable characteristics of two generous, talented, and successful scientists.

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